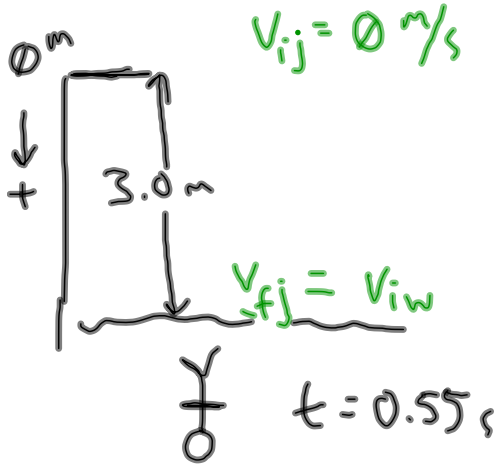
Collision Practice Problems and Notes 1st Block 10.7.11

An 82 kg man drops from rest on a diving board 3.0 m above the surface of the water and comes to rest 0.55 s after reaching the water. What is the net force on the diver as he is brought to rest?



$v_{ij} = 0$ m/s

$h = 3.0$ m $= \Delta y$

$t = 0.55$ s

$m = 82$ kg

$v_{fw} = 0$ m/s

$$\bar{F}_w \Delta t = m \Delta \bar{v}_w$$

$$\bar{F}_w = \frac{m \Delta \bar{v}}{\Delta t}$$

$$= \frac{m(\bar{v}_{fw} - \bar{v}_{iw})}{\Delta t}$$

$$= -\frac{m \bar{v}_{iw}}{\Delta t}$$

$$= -\frac{(82\text{ kg})(7.67\text{ m/s})}{0.55\text{ s}}$$

$$= -1144\text{ N}$$

$v_{fj}^2 = v_{ij}^2 + 2 a_g \Delta y$

$v_{fj} = \sqrt{2 a_g \Delta y}$

$= \sqrt{2(9.8\text{ m/s}^2)(3\text{ m})}$

$= 7.67$ m/s

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A skateboarder is moving 7.7 m/s down a road. She leans back to pop up her front wheels and grind the board to a stop. It takes her 4.4 seconds to come to a stop. The skateboarder and board's combined mass is 58.0 kg.
a) Where/what is the momentum in this situation?
b) Where/what is the impulse in this situation?
c) What must happen in order to bring the momentum of the skater down to zero (in terms of impulse)?
d) Calculate how much force was needed to bring this skateboarder to a stop.
e) Where is this force coming from?
f) Does this force happen all at once?

a) girl and skateboard

b) force of friction slowing the girl down

c) force must continue for enough time for girl to stop

d) $\bar{J} = \Delta\bar{p}$

$$\bar{F}\Delta t = m\Delta\bar{v} = m(\bar{v}_f - \bar{v}_i)$$

$$F = \frac{m(v_f - v_i)}{\Delta t}$$

$$= \frac{(58.0\ kg)(0\ m/s - 7.7\ m/s)}{4.4\ s}$$

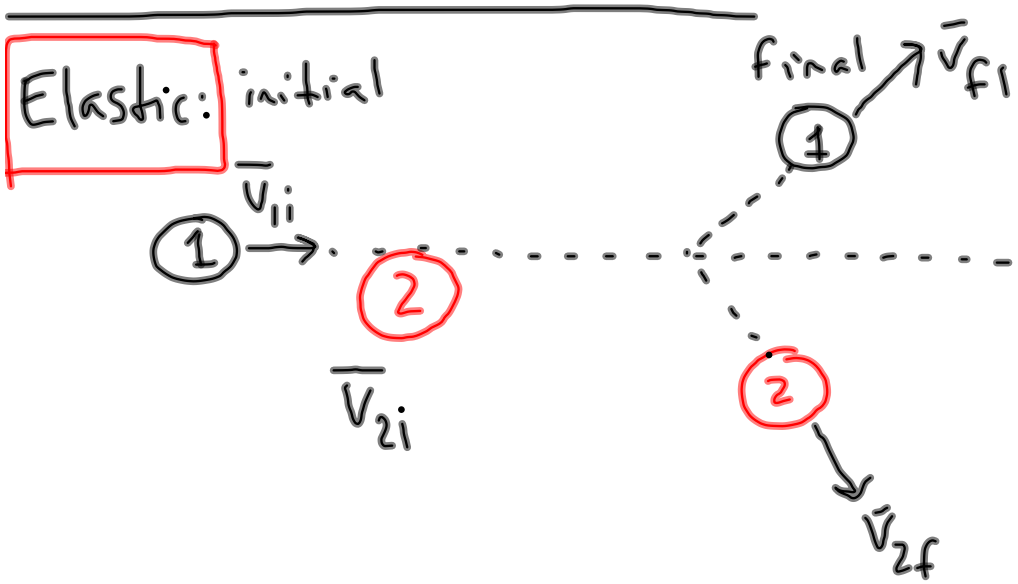
$$= -102\ N$$

e) force of kinetic friction

f) No, it takes 4.4 s

Collisions in 2-D:

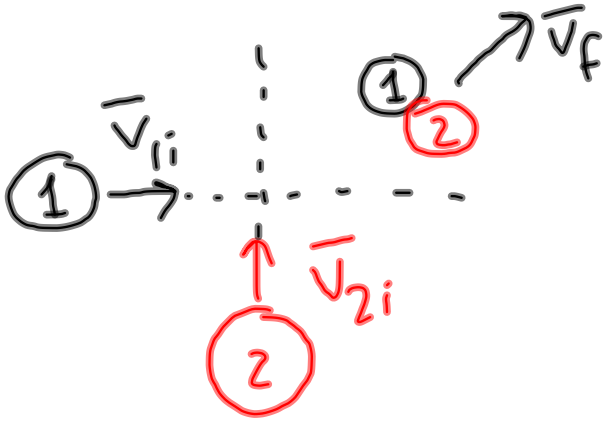
Elastic:



$$\bar{p}_{1xi} + \bar{p}_{2xi} = \bar{p}_{1xf} + \bar{p}_{2xf}$$

$$\bar{p}_{1yi} + \bar{p}_{2yi} = \bar{p}_{1yf} + \bar{p}_{2yf}$$

Inelastic:



$$\bar{p}_{1ix} + \bar{p}_{2ix} = (m_1 + m_2)\,\bar{v}_{fx}$$

$$\bar{p}_{1iy} + \bar{p}_{2iy} = (m_1 + m_2)\,\bar{v}_{fy}$$

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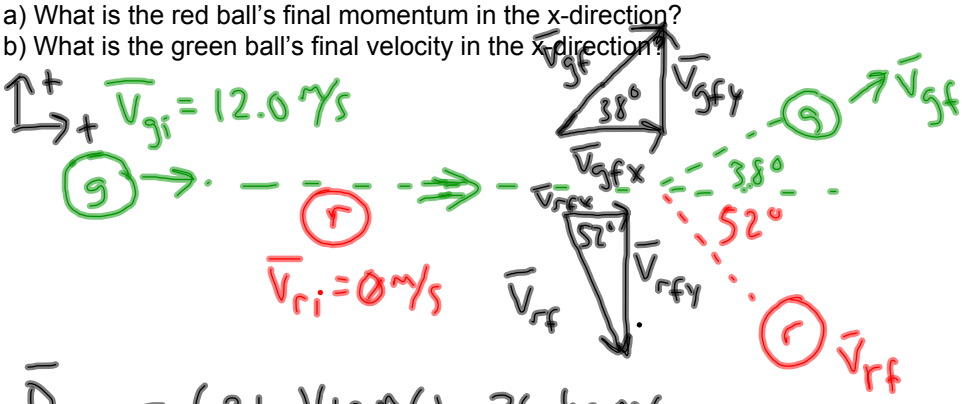
A green 3.00 kg ball moving 12.0 m/s hits a non-moving red 2.00 kg ball. After they hit, the red ball is moving to the right at a 52.0^0 angle from the green ball's original direction. The green ball is now moving at a 38.0^0 angle to the left of its original direction.

a) What is the red ball's final momentum in the x-direction?

b) What is the green ball's final velocity in the x-direction?



$$\bar{P}_{gix} = (3\,kg)(12\,m/s) = 36\,kg\cdot m/s$$

$$\bar{P}_{giy} = (3\,kg)(0\,m/s) = 0\,kg\cdot m/s$$

$$\bar{P}_{rix} = 0\,kg\cdot m/s$$

$$\bar{P}_{riy} = 0\,kg\,m/s$$

$$\bar{P}_{gfx} = m_g v_{gf} \cos(38^\circ)$$

$$\bar{P}_{gfy} = m_g v_{gf} \sin(38^\circ)$$

$$\bar{P}_{rfx} = m_r v_{rf} \cos(52^\circ)$$

$$\bar{P}_{rfy} = -m_r v_{rf} \sin(52^\circ)$$

$$\begin{cases} \bar{P}_{gix} + \cancel{\bar{P}_{rix}}^{\,0} = \bar{P}_{gfx} + \bar{P}_{rfx} \\ \cancel{\bar{P}_{giy}}^{\,0} + \cancel{\bar{P}_{riy}}^{\,0} = \bar{P}_{gfy} + \bar{P}_{rfy} \end{cases}$$

$$\begin{cases} \bar{P}_{gix} = \bar{P}_{gfx} + \bar{P}_{rfx} \\ \bar{P}_{gfy} = -\bar{P}_{rfy} \end{cases}$$

HW:

p. 209: 2, 3

p. 214: 1, 2